

GENERAL NOTES

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TWO RELATED MIGRATIONS OF THE CALIFORNIA TORTOISE-SHELL BUTTERFLY IN MARIPOSA COUNTY, CALIFORNIA, IN 1986

Additional key words: Nymphalidae, *Nymphalis californica*, hibernation.

Mass exodus flights of the California tortoise-shell butterfly, *Nymphalis californica* (Boisduval) (Nymphalidae), usually follow defoliation of *Ceanothus*, the larval host, in years of abnormal temperatures and subnormal precipitation such as droughts (Shields 1987, *Utahensis* 7(1):5-13). Years of peak migration in the Yosemite National Park region include 1911, 1922, 1933, 1961-62, 1971-72, and 1986-87. This note reports two related February-May 1986 migrations of *N. californica* near the SW end of Yosemite, and proposes the source to terminus route for the hibernant flight.

In late July 1986 there were extensive migrations for 42 km in the Donner Pass region of Placer and Nevada counties; these flew SW and W (Knaus & Lambremont 1987, *J. Lepid. Soc.* 41:121-122), independent of the Yosemite migrations in source, timing, and (partially) direction. A syndrome of behavioral, physiological, and ecological characteristics in migratory butterflies follows decreased production of juvenile hormone (Rankin 1978, pp. 5-32 in Dingle (ed.), *Evolution of insect migration and diapause*, Springer-Verlag, New York; Herman & Dallmann 1981, *J. Insect Physiol.* 27:163-168).

In 1986 at the Shields residence, Jerseydale, 1100 m elev., 14 km NE Mariposa, Mariposa Co., California, sightings were made along a NW-SE 30 m front in a pine forest clearing between cabins. Flight directions were recorded with a hand compass that had been checked against a surveyor's compass. It was placed on level ground and oriented to magnetic N (17½°E of true N) to estimate flight directions. All times are PST.

On 24 February 1986 in Skelton Canyon E of Jerseydale, worn hibernant *N. californica* were abundant (150-200 seen), most muddy areas having at least 10 or 20, sometimes 40 or 50, in mid-morning on a warm, sunny, humid day (22°C). These were from a fall 1985 emigration that had subsequently become resident. A small migration not participated in by residents began on 26-27 February, and was confined to the canyon summit. A heavy rain (500 mm in Mariposa) fell on 15-19 February, followed during 24-28 February by warm, clear, sunny, humid weather (low 20's C).

This migration was first noticed on 28 February at Jerseydale (Table 1) beginning at 0930 h and ceasing at 1605 h. Migrants flew up to 15-30 m above the ground, passing over pine trees instead of around them. A few changed direction when reaching the forest; these often appeared in groups of 2 to 4. A resident population (common but nonmigrating) was present at Jerseydale at this time. During March, no migration was seen on overcast days. A maximum migration of 75/h/30 m was reached on 1 March between 1100 and 1200 h (Table 1). After some rain and snow in early and middle March, the migration resumed during 19-27 March with 21-61/h/30 m, reducing to 1-2/h/30 m from the end of March to 22 April. The flight rate (measured by car speedometer) was 32-40 km/h. In unforested areas between Darrah and Big Spring Hill, the flight was only 1-2 m above the ground. By late March many individuals had clear or tattered wings, and by mid-April many were exceedingly worn and flying slowly. In the early morning, the flight direction paralleled the incoming rays of sunlight. On 27 March, migrants were sometimes seen in 3's flying in V-formation. During its peak, migration began at 0920-0930 h and ceased at 1502-1605 h. In late February-early March, it was confined to an area between Jerseydale and Big Spring Hill (11 air km) with none migrating on either side of this front, such as at Briceburg or Mariposa. On 27 March a few *N. californica* were seen migrating ESE at 1100-1220 h on Hunter Valley Mtn., 610-915 m elev., 29 air km NNW of Jerseydale.

TABLE 1. 1986 migrations of *Nymphalis californica* at Jerseydale.

Date	Time (h) (PST)	Predominant direction ^a	Numbers/ 30-m front/h	Percent in predominant direction
Hibernants				
27 February	1420-1500	SE	5 ^b	100
28 February	1350-1415	SE	5 ^b	100
28 February	1420-1605	ESE	87 ^b	100
1 March	1100-1200	SE	75	90
19 March	1250-1350	—	22	— ^c
21 March	1250-1350	SE	61	48
22 March	1100-1200	SE	40	65
24 March	1200-1300	ESE	26	46
26 March	1200-1300	ESE	34	44
26 March	1440-1540	ESE	24	71
27 March	0920-1000	ESE	24 ^b	54
19 April	1100-1200	SE	2	100
First Brood				
24 May	1230-1330	WNW	29	38
25 May	0915-1015	E	12	33
25 May	1430-1530	W	14	43
25 May	1530-1630	W	5	80
26 May	0815-0915	—	10	— ^d
26 May	1130-1230	none	8	—
27 May	1430-1530	W	8	38
28 May	1024-1125	W	19	37
28 May	1330-1430	NW	6	33
31 May	1030-1130	W	7	71

^a Predominant direction refers to greatest percent traveling in any one direction.

^b Rate/h unknown.

^c All but one flew SE to ESE.

^d 40% flew W and 40% flew E.

The source area for the hibernant *N. californica* migration passing through Jerseydale was probably the Vaca Mts. W of Davis. Projecting the SE line of flight backwards intersects this region 230 km from Jerseydale (Fig. 1). There were hundreds to thousands of adults in canyons of the Vaca Mts. in February and March of the migration (A. Shapiro pers. comm.; News Lepid. Soc. 1987, no. 2, p. 17). By May there were fewer larval colonies in the Vacas than would have been expected from their earlier numbers. Projecting their SE line of flight forward from Jerseydale bisects the eastern Sierra Nevada between Lone Pine Creek and Big Pine Creek where D. Giuliani commonly saw nonmigrating adults from 26 February to 11 March of the migration. These were along streams in all canyons from 1980 m down to the valley floor (Fig. 1). None was seen there by 8-11 April 1986. This area is 185 km from Jerseydale and indicates a total of 420 km traveled by part of the migration. The distance between Lone Pine and Big Pine creeks is 65 km, indicating a 6-fold increase in width at the migration's terminus when compared with the Jerseydale-Big Spring Hill width. The rate of travel from beginning to end was 1.5-2.4 days based on 420 km distance, 32-40 km/h flight speed, and 0920-0930 h to 1502-1605 h flight times.

A brief migration of smaller, fresher, first-brood *N. californica* flew through Jerseydale later, in late May 1986 (5-29/h/30 m) (Table 1). On 20 May, 15 fresh adults were flying about, and 5 others were seen migrating. On 21-23 May, days were cool and overcast. The peak flight occurred on 24 May. Flight was near the ground and slower (10-12 km/h) than the hibernant migration. On 26 May along Footman Ridge summit, 1400 m elev.,

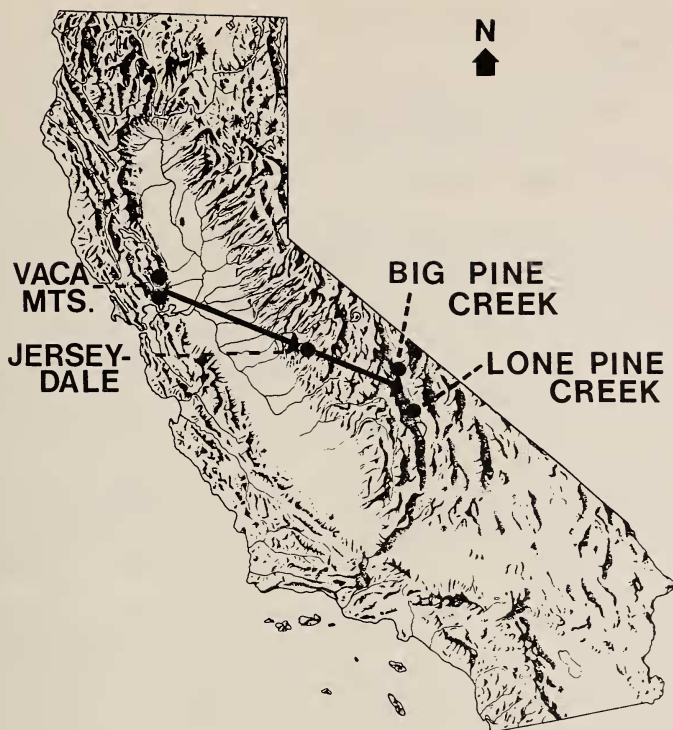


FIG. 1. SE migration of *N. californica* hibernants in 1986.

1 km E of Jerseydale, 6 butterflies were seen migrating W to NW at 0955–1010 h. During late May, migration began at 0838 h and ceased at 1620 h, thus occupying a greater part of the day than the hibernant migration. For 1 h earlier and $\frac{1}{2}$ h later than this, specimens flew back and forth in the clearing and gully, basked, or alighted on trees. By 31 May most migrants were in intermediate wing-wear condition. Migration ceased during the first week of June. Three of 10 specimens collected on 24 May expelled meconia, indicating a nearby source area. This brood was likely the progeny of the hibernant migration. No *N. californica* were seen at Jerseydale during the summer until 25 August when one fresh specimen appeared. A few resident adults reappeared during the fall and early winter of 1986.

Hibernant and first-brood migrations each had their own flight directions (SE vs. W). Greatest variability in direction occurred during breezy weather, with least variability on calm days.

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OAKLEY SHIELDS, 4890 Old Highway, Mariposa, California 95338.

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